



Ballooncraft

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Ballooncraft Systems

ULDB

Wallops Flight Facility

- **Power Systems**
- **Cryo-Refrigeration**
- **Telemetry**
- **Data Handling and Processing**
- **Attitude Control**
- **Positioning Systems**
- **Mechanical Systems**
- **Thermal Control**



ULDB Power Systems

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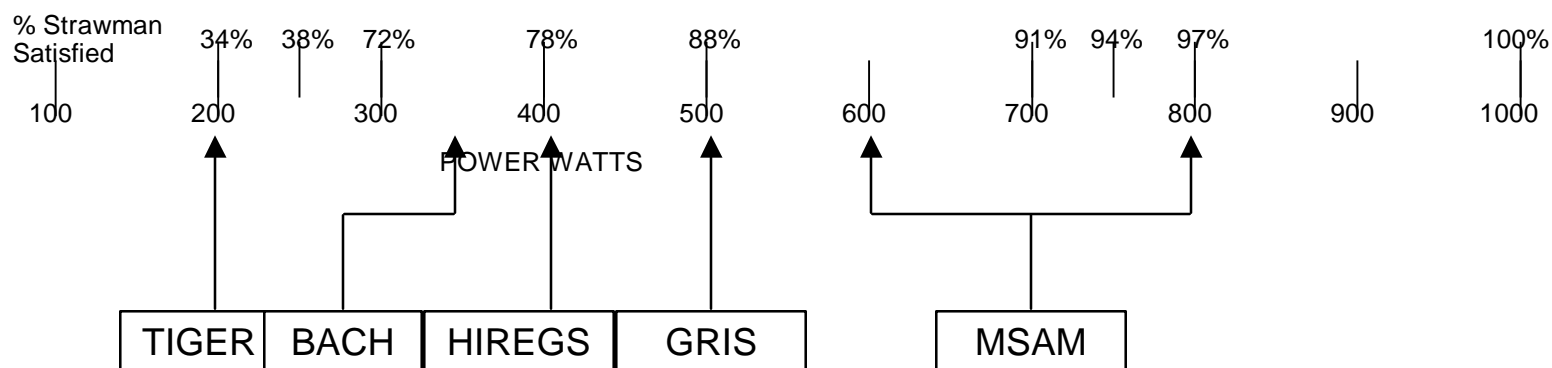
Wallops Flight Facility

- **Requirements**

- **Various Flight Profiles**

- » Polar “summer” flights - 24 hours/day sunlight
 - » Polar “winter” flights - 24 hours/day darkness
 - » Mid-latitude flights - day/night cycles

- **Wide Range of Science Support Requirements**





ULDB Power Systems

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- **Current Balloon Program Capabilities**
 - Lithium Batteries
 - LDB solar power system
 - » Dual charge controllers, each 60 watts
 - » Omni-directional panel array
 - » Silver-Zinc rechargeable wet cells
- **Potential Technologies**
 - Advanced Solar Power Systems
 - » Omni-directional and sun tracking panels
 - » Deployable panels
 - » Higher power density rechargeable batteries
 - Other Power Sources
 - » Wind/electric generators
 - » Fuel Cells or other Primary Battery sources
 - » Flywheel systems, Sterling engine systems



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Cryo-Refrigeration

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- **Requirements**
 - Develop system/capability to meet science detector cooling requirements
 - » Very low cost mechanical refrigerator systems capable of cooling more than one Watt of input load to ~90K.
 - » Systems capable of cooling small thermal loads to 4K.
- **Current Balloon Program Capabilities**
 - Scientists have provided their own Liquid Nitrogen Dewers
 - Prohibitively large amounts of Liquid Nitrogen and/or Liquid Helium would be needed for 100 day flights
- **Potential Technologies**
 - Electromechanical Cryo-Refrigeration Systems
 - » ACE Project - hydrogen sorption cooler has been developed as a joint UCSB-JPL effort as a flight prototype for the PLANCK mission



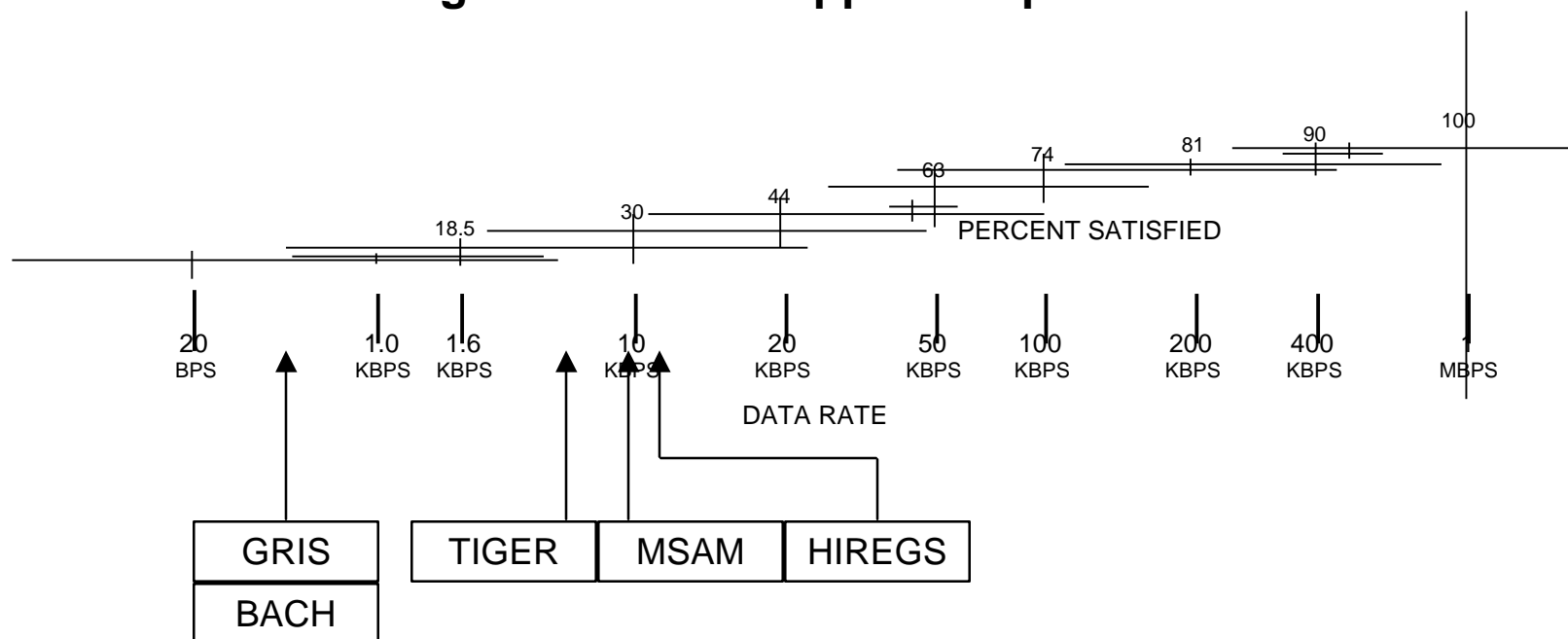
ULDB Telemetry

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- **Requirements**

- **Global two-way digital communications for telemetry and command**
- **Both Polar and Mid-Latitude solutions needed**
- **Wide Range of Science Support Requirements**





ULDB Telemetry

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- **Current Balloon Program Capabilities**
 - ARGOS
 - TDRSS
 - Inmarsat Standard C
 - HF Command
- **Potential Technologies**
 - **Satellite Communications**
 - » Geostationary
 - » LEO and MEO
 - » NASA, Military, Commercial, Amateur
 - **Steerable Antennas**
 - » Planar arrays (phased arrays)



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Data Handling & Processing

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- **Requirements**
 - Experiments require on-board data storage
 - Project requires high reliability, radiation tolerant data acquisition, processing, and storage systems
- **Current Balloon Program Capabilities**
 - Citadel 486 ruggedized flight computer, custom software
 - Custom developed data acquisition system
 - Custom developed command decoder with custom format
 - Ruggedized 1GB hard drives in pressurized container for data archive
- **Potential Technologies**
 - Higher capacity data storage that operates at ambient
 - Space mission technologies (architecture and systems)



ULDB Attitude Control

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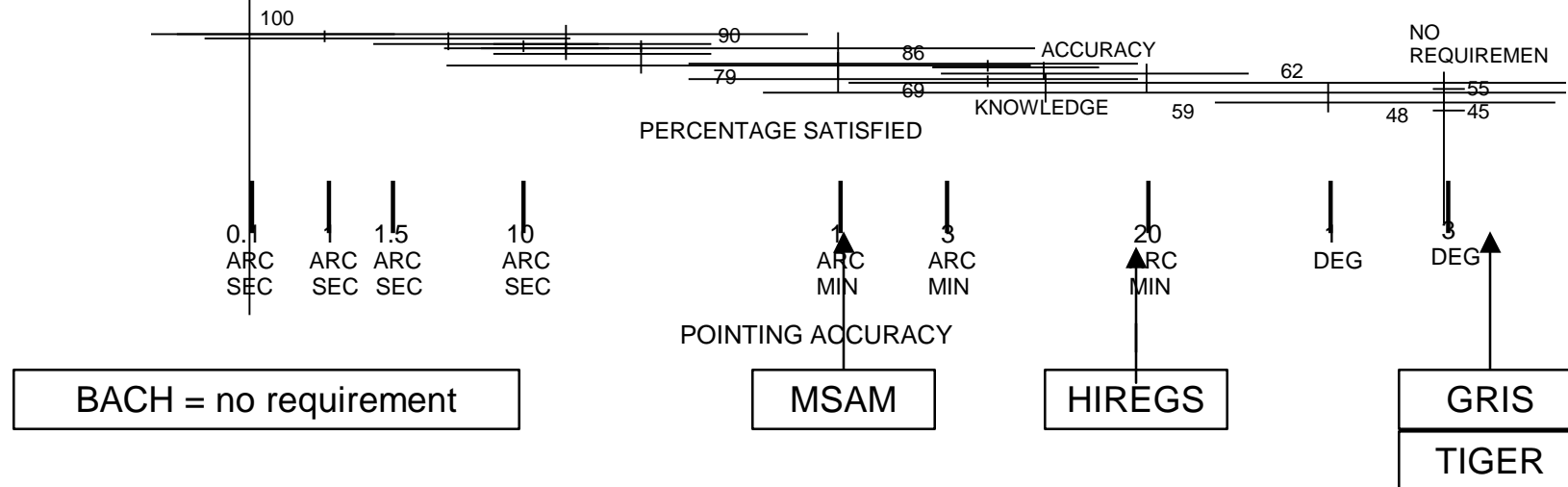
- **Requirements**

- Coarse Azimuth Pointing for directional solar panels
- Elevation pointing for experiment detectors
- Wide Range of Science Support Azimuth Requirements
 - » None, spin scan, several degrees, sub-arcsecond

LEGEND

■ ACCURACY

■ KNOWLEDGE





ULDB Attitude Control

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- **Current Balloon Program Capabilities**
 - **WFF Pointing System**
 - » 2 to 3 degree accuracy for solar panel pointing
- **Potential Technologies**
 - **Improved Sensors**
 - » Fiber optic gyros
 - » Phase comparison GPS orientation
 - » Star Cameras
 - **Mechanical Systems**
 - » Improved decoupler
 - » Load train improvements
 - » Active damping



ULDB Positioning Systems

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- **Requirements**
 - Latitude, Longitude and Altitude of Balloon for Flight Control, Safety, and Science Requirements
- **Current Balloon Program Capabilities**
 - Dual redundant GPS receivers
 - ARGOS transmitters
 - » Location accuracy <3 km.
- **Potential Technologies**
 - Current systems work well
 - Change to 1553 bus may require different GPS units



ULDB Mechanical Systems

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- **Requirements**
 - Structures
 - Electromechanical Systems
 - » Ballast Valves
 - » Electric Motors
 - » Deployment Mechanisms
- **Current Balloon Program Capabilities**
 - Structures
 - » Aluminum structures
 - Pyrotechnics
 - Globe motors
- **Potential Technologies**
 - Advanced composites
 - Space Qualified Electromechanical devices
 - Computer Aided Design and Modeling



ULDB Thermal

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- **Requirements**
 - Thermal control materials
 - » Continuous light, continuous dark, day/night cycles
 - Analysis Software
- **Current Balloon Program Capabilities**
 - Materials
 - » Silverized Teflon
 - » White Paint
 - Analysis Software
 - » TRASYS and SINDA
- **Potential Technologies**
 - Space technology materials
 - Advanced modeling
 - Active thermal control systems